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DIRECTORATE OF INTELLIGENCE

Intelligence Memorandum

International Finance Series No. 35

A Model to Predict the Impact of the Exchange-Rate Agreement on International Trade

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
March 1972

INTELLIGENCE MEMORANDUM

A MODEL TO PREDICT THE IMPACT OF THE EXCHANGE-RATE AGREEMENT ON INTERNATIONAL TRADE

Introduction

1. This memorandum uses a trade-flow model to examine the impact on international trade of the international realignment of parities reached 18 December 1971. The model is similar to that developed and used by the International Monetary Fund (IMF), an approximation of which was described in an earlier memorandum of this Office.[1]

2. The model was substantially advanced and refined for this memorandum and now explicitly reflects the time lags in trade-balance adjustment and the impact of international differences in rates of economic growth. However, the model still does not reflect international differences in rates of inflation, the impact of most trade restrictions, or numerous other influences on international trade. The parameters are, except for Japan, those used by the IMF and have not been tested. For these reasons, the model's predictions should be used with great care, bearing in mind the simplified assumptions on which they are based. Pending further refinements and testing, these results should be regarded as indications of general orders of magnitude and not as estimates of this Office.

Note: This memorandum was prepared by the Office of Economic Research.

Discussion

The Model

3. In the period after 15 August 1971 the IMF hoped to facilitate early agreement on new exchange rates by recommending a package of new currency parities designed to achieve trade-balance targets similar to that suggested by the Organization for Economic Cooperation and Development (OECD). In making these recommendations the Fund used a trade-flow model developed by its staff. A description of the model and the assumptions made about its parameters have been published.(2)

4. We have developed a trade-flow model with the basic structure of the Fund model but with several additions. The CIA model – unlike the IMF model – not only includes equations indicating the relationship between price changes and changes in the amount of goods supplied and demanded, but also equations reflecting the delay before the full impact of the parity changes is felt. Our model, moreover, permits real output in each country to vary, while the IMF model assumes real output in each country remains constant. By varying the rate of growth of real output, we can explicitly consider the impact of national business cycles on the trade balances.(3)

The Smithsonian Agreement

5. The agreement reached by the Group of Ten (Belgium, Canada, France, West Germany, Italy, Japan, Netherlands, Sweden, the United Kingdom, and the United States) and Switzerland on 18 December 1971 ended a four-month period of floating exchange rates and increasing monetary uncertainty. Its key features include a 7.9% devaluation of the US dollar relative to gold; an 8.6% appreciation both of the British pound and French franc; a 13.6% appreciation of the German mark; and a 16.9% appreciation of the Japanese yen, all relative to the dollar. The Canadian dollar – floating since May 1970 — continues to trade at about an 8% premium over its previous parity with the US dollar (see Table 1). For comparative international accounts of these countries, see Table 2.

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3. The CIA model is described in detail and evaluated in the Appendix.

Table 1

Exchange-Rate Changes from pre-May 1970 Parities

Percent

Country	Relative to Gold	Relative to the US Dollar
United States	-7.9	--
Japan	7.7	16.9
Canada	Continues to float	Nearly 8.0
Belgium-Luxembourg	2.8	11.6
France	No change	8.6
Italy	-1.0	7.5
Netherlands	2.8	11.6
Sweden	-1.0	7.5
Switzerland	4.9	13.9
United Kingdom	No change	8.6
West Germany	4.6	13.6
Other OECD a/	-1.1	7.4

a. Excluding Australia and Yugoslavia; including Austria, Denmark, Finland, Greece, Iceland, Ireland, Norway, Portugal, Spain, and Turkey; weighted by 1970 export shares.

Table 2

Comparative International Accounts, 1971 a/

Million US $

Country	Trade Balance	Exports f.o.b.	Imports f.o.b.	Current Account Balance	International Reserves as of December
United States	-2,840	*42,800*	*45,640*	-1,520	13,190
Japan	7,900	*23,630*	*15,730*	5,880	15,360
Canada	2,230	*17,670*	*15,440*	50	5,700
Belgium-Luxembourg	540	*10,330*	*9,790*	600	3,470
France	780	*22,550*	*21,770*	-420	7,490 b/
Italy c/	-400	*14,290*	*14,690*	850	6,790
Netherlands	-260	*15,100*	*15,360*	-390	3,800
Sweden	300	*7,300*	*7,000*	140	1,110
Switzerland	-1,750	*5,700*	*7,450*	-210	6,970
United Kingdom	700	*21,300*	*20,600*	2,150	6,580
West Germany	7,910	*42,200*	*34,290*	160	18,380

a. Preliminary, except entry for International Reserves.
b. As of November.
c. Transactions basis except entry for International Reserves.

Its Trade Impact

6. Our detailed examination of the agreement's impact comprises two cases. For each we make different assumptions about the time period covered and about the rates of real-output growth. In the first case – the comparative static (or long-run equilibrium) case – we hold real output in each country constant. This assumption permits us to separate the effect of price changes from the effect of income changes.[4] This, in turn, enables us to isolate the direct impact of the parity realignment. Thus Case 1 results are not a prediction of the actual changes that will take place in the trade balances over any particular time period, but rather indicate how the price effect of the Smithsonian realignment alters these balances in the long run from what they would have been in the agreement's absence. Conceptually, Case 1 corresponds to the analysis undertaken by the IMF staff during the exchange-rate negotiations.[5]

7. In Case 2 – the dynamic case – we permit real output in each country to grow at an exogenously determined rate. This assumption allows us to consider simultaneously both the price and income effects of parity and real-output changes. Thus Case 2 results are predictions of the changes in the trade balances in the near term, given assumed rates of growth of real national output.

8. In both cases the results are given in current US dollar prices. These prices will rise because of the appreciation of most important currencies relative to the dollar. In addition, Case 2 prices will rise because of increasing demand pressures. In the first case the price rise accounts for approximately 12% of the increase in the dollar value of world trade; in the second, world trade prices in dollars will increase at an average annual rate of about 13% over the period.

Assumptions

9. The exchange rate agreement's trade impact depends, in part, on the parameter values chosen to indicate the strength of the casual linkages among changes in prices and changes in flows. The parameter values used in the model are the same as those employed by the IMF; they are described

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4. Parity changes induce changes in real output as well as in prices and trade balances; these induced real-output changes, in turn, indirectly, further affect prices and trade balances. Governments, however, can adjust the rate of real-output growth to some desired level. We assume, therefore, in isolating the direct price effect, that real output in each country remains unchanged and that the indirect price and trade-balance effects are neutralized. 25X1

in the Appendix. However, we make an adjustment in the case of Japan, which has experienced far greater growth rates for both GNP and exports than any other OECD country. We assume that Japan's outstanding export performance of the 1960s will continue through 1974. We assume, accordingly, that the Japanese supply elasticity is one and one-half times larger than the supply elasticity of other countries – that is, for any given percentage increase in price, the Japanese will increase their output in percentage terms one and one-half times more than other producers. Even with this adjustment, the assumption that all countries have the same demand and supply elasticities is, of course, a great oversimplification. In reality these parameters undoubtedly differ among countries as a result of differences in the composition of trade and in their economic policies and institutions.

10. The relatively high proportion of Japanese trade subject to quantitative restrictions necessitates a further adjustment. Commodities making up about 40% of Japanese exports are covered either by quotas in importing countries or by a variety of voluntary Japanese restraints and export controls. Japan's trade would probably not respond, therefore, to the parity realignment in the way predicted by an unadjusted model. It is consequently assumed that those exports covered by quantitative restrictions grow 10% annually in value terms (beyond the 16.9% adjustment for yen revaluation). Although some Japanese imports are also covered by quotas or other quantitative restrictions, the proportion is probably not high in absolute terms nor in relation to the quantitative import restrictions maintained by several other countries included in the model. The Japanese do make widespread use of informal import restrictions, but there is no way to measure their impact. Even with the adjustments made, the model may lead to some overstatement of the impact of the parity realignment on Japanese trade. Failing to take the restrictions of other countries explicitly into account may also cause some overstatement of impact.

11. The exchange-rate agreement's trade impact also depends, in part, on the non-OECD countries' actions. Estimates of the US trade-account improvement made with the assumption that these countries do not, on the average, further alter their exchange rates or import policies are likely to understate substantially the size of the US improvement. Developing countries – accounting for the bulk of non-OECD country trade – in particular, are unlikely to allow a considerable improvement in their trade balances to occur. Instead, they are likely to increase their imports by means of other policy measures such as easing of import controls. We assume, therefore, that the manufactured imports of all non-OECD countries taken as a group rise by one-half of the improvement in their aggregate trade balance implied by the Smithsonian agreement. These additional imports are distributed according to each OECD country's share in total OECD manufactured exports to non-OECD countries, with the United States accounting for about 25% of the total.

Case 1 – Equilibrium Impact

12. The long-run equilibrium impact of the exchange rate agreement – with real output in each country remaining constant – is shown in Table 3 for each of the Group of Ten countries and Switzerland, for other OECD countries as a group, and for the non-OECD countries as a group. The values in the table indicate in current prices, on an annual basis, by how much the price effect of the Smithsonian realignment would alter each country's total trade balance and its bilateral balance with the United States, as compared with what these would have been in the agreement's absence.

13. Using the model, we calculate that the price effects of the Smithsonian agreement would improve the US trade account by around $11.5 billion on an annual basis, or nearly the amount sought. Higher exports account for most of the improvement; they increase about $9.5 billion in the period over what they would have been in the agreement's absence. Imports would decline about $2.0 billion. On a commodity basis, the greatest improvement would be in US exports of manufactures, which should increase about $8.0 billion; US imports of these products should decline by about $2.1 billion (see Table 4). Trade-balance improvements of about $650 million each are also projected in US trade in food products and crude materials.

14. The model indicates that Japan would experience sharp trade-account losses because of the agreement. Japan's imports would increase about $4.1 billion while its exports are expected to increase only $1.3 billion. About 40% of the expected deterioration in Japan's total trade account is accounted for by the deterioration in its bilateral trade with the United States. Japanese exports to the United States, according to the model, would hardly increase at all while Japanese imports from the United States would increase about $1.2 billion.

15. Among European countries the sharpest deterioration in trade account would occur in West Germany – about $3.3 billion – and in the United Kingdom – about $1.7 billion. Although the French franc appreciated relative to the dollar by the same amount as the British pound, the French trade account would deteriorate only slightly because, relative to the currencies of their trade partners, the franc appreciated much less. A large proportion of French trade is with West Germany, while most UK trade is with the European Free Trade Area (EFTA) countries,[6] the United States, and Canada.

6. Including Austria, Denmark, Finland, Ireland, Norway, Portugal, Sweden, Switzerland, and the United Kingdom.

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Table 3

Case I: Static Equilibrium Impact of Agreement a/

Million US $

Country	Change in Total Trade Account			Change in Bilateral Account With the United States		
	Balance	Exports f.o.b.	Imports f.o.b.	Balance	Exports f.o.b.	Imports f.o.b.
United States	11,504	*9,485*	*-2,019*	--	--	--
Japan	-2,798	*1,317*	*4,115*	1,140	*15*	*1,155*
Canada	-1,464	*276*	*1,740*	2,091	*-503*	*1,588*
Belgium-Luxembourg	-898	*1,034*	*1,932*	512	*-122*	*390*
France	-128	*2,028*	*2,156*	513	*-111*	*402*
Italy	-109	*1,457*	*1,566*	467	*-149*	*318*
Netherlands	-1,141	*1,092*	*2,233*	561	*-65*	*496*
Sweden	-130	*702*	*832*	198	*-53*	*145*
Switzerland	-1,054	*235*	*1,289*	331	*-85*	*246*
United Kingdom	-1,684	*1,383*	*3,067*	928	*-268*	*660*
West Germany	-3,308	*1,903*	*5,211*	1,423	*-565*	*858*
Other OECD b/	-1,192	*1,599*	*2,791*	623	*-106*	*517*
Rest of world	2,403	*6,517*	*4,114*	2,717	*-7*	*2,710*

a. Change in world trade prices (in US dollars) = 11.6%.
b. Excluding Australia and Yugoslavia.

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Table 4

Equilibrium Impact of Agreement:
Commodity Composition of Change in US Trade

Million US $

	Food	Crude Materials	Mineral Fuels	Manu-factures
Balance	680	637	76	10,111
Exports f.o.b.	*718*	*643*	*145*	*7,979*
Imports f.o.b.	*38*	*6*	*69*	*-2,132*

16. The Canadian dollar's appreciation – assuming it continues to trade at near parity with the US dollar – results in a worsening of Canada's trade account by about $1.5 billion from what it would have been in the agreement's absence. The deterioration in the bilateral account with the United States more than accounts for the change in Canada's total trade account; Canadian exports to the United States decline about $0.5 billion, and Canadian imports from the United States increase about $1.6 billion.

Case 2 – Trade Impact in 1972-74

17. The speed with which the full impact of the parity changes is felt depends on two factors. First, there is a lag in the response of producers and consumers to new market conditions. Second, there is a delay between the time contracts are negotiated and prices set and the time merchandise covered by these contracts enters the importing country's market. We assume that the delay between contract and import averages six months, during which time the new parity changes have no impact on the trade balances (in terms of dollars). The parity changes influence the trade balances in subsequent periods, but their full impact is still not felt. This is so because it is assumed that suppliers and consumers make their production and consumption decisions in light of past, as well as current, prices and incomes (for details see the Appendix).

18. The exogenously determined rates of real-output growth used in the model are derived primarily from OECD estimates. For 1972, we assume that real output of each country grows at the GNP (or GDP) growth rates estimated by the OECD. For the first half of 1973, we assume real output grows at a rate midway between the growth rates in the second halves of 1972 and 1973. For the second half of 1973 and for 1974, we assume that real output grows at rates the OECD believes are required to achieve

full employment by 1974-75. We also assume that parities do not change during the period; thus assumed differences in rates of real-output growth have a very strong influence on the trade balances, particularly in the latter part of the period, when much of the impact of the Smithsonian realignment would have already been felt.

19. The dynamic trade impact of the exchange-rate agreement is shown in Table 5. The values in the table are projections in current prices of changes in trade balances for the given real-output growth rates, assuming that the basic structure of international trade relations is not altered. Changes in tariff and non-tariff barriers, EC enlargement, major new innovations, and other structural changes would alter these predictions.

20. The model projects a substantial improvement in the US trade account during 1972-74 despite the assumed rapid growth in US output. In the first half of 1972, however – before the parity changes have an impact on the trade balances – the trade account deteriorates by about $900 million. Such a deterioration, although anticipated by most analysts, could increase uncertainties in foreign exchange markets and precipitate further speculative capital movements. In the second half of 1972, the trade account, improving by about $2.3 billion, would show a slight deficit. Overall, in 1972 the US merchandise trade account would show a deficit of about $3.6 billion, or about $800 million more than in 1971. The model shows that the US trade account would swing into surplus in the second half of 1973, and by the end of 1974, on a semiannual basis, it would be in surplus by about $1.6 billion, or $2.8 billion for the year. Thus the swing in the US trade balance would be about $5.6 billion (at an annual rate) over the three-year period.

21. Although the introduction of time lags and a real-output variable makes the model more realistic, some important variables continue to be omitted. There is in particular no attempt to project the rate of inflation, apart from those price increases that directly stem from the parity and income changes themselves. Past experience indicates that different economies respond differently to demand pressure and suffer from cost-push inflation to different degrees, depending on their institutions and policies and on the growth of productivity. In the late 1960s, US export prices grew substantially more rapidly than those of our competitors. A continued relatively poor export price performance in the future would reduce the impact of the parity realignment, and the improvement in the US trade account would be smaller than predicted.

22. Although Japan's trade account is expected to deteriorate during the period because of the large yen revaluation and the economy's very rapid growth, the Japanese would continue to run a large surplus. The model predicts that during the first half of 1972 Japan's record trade surplus will

Table 5

Case 2: Dynamic Impact of Agreement a/

Country and Indicator	Jul-Dec 1971 b/	1972 Jan-Jun	1972 Jul-Dec	1973 Jan-Jun	1973 Jul-Dec	1974 Jan-Jun	1974 Jul-Dec
United States							
Assumed annual real growth of GNP (percent)		5.75	6.00	6.85	6.50	6.50	6.50
Trade balance (Million US $)							
Change		-900	2,301	463	594	785	453
Total	-2,070	-2,970	-669	-206	388	1,173	1,626
Japan							
Assumed annual real growth of GNP (percent)		6.90	7.00	8.50	10.00	10.00	10.00
Trade balance (Million US $)							
Change		-318	-531	-86	-145	-317	-361
Total	4,490	4,172	3,641	3,555	3,410	3,093	2,732
Canada							
Assumed annual real growth of GNP (percent)		6.25	6.50	6.50	6.50	6.50	6.50
Trade balance (Million US $)							
Change		278	-106	108	214	184	167
Total	790	1,068	962	1,070	1,284	1,468	1,635
Belgium-Luxembourg							
Assumed annual real growth of GNP (percent) c/		3.25	3.75	4.32	4.90	4.90	4.90
Trade balance (Million US $)							
Change		251	-30	64	105	172	163
Total	270 d/	521	491	555	660	832	995
France							
Assumed annual real growth of GNP (percent)		5.00	5.00	5.37	5.75	5.75	5.75
Trade balance (Million US $)							
Change		-27	-87	-98	-74	3	-46
Total	330	303	216	118	44	47	1
Italy							
Assumed annual real growth of GNP (percent)		3.00	5.00	5.50	6.00 e/	6.50	6.50
Trade balance (Million US $)							
Change		49	-386	-169	-168	-255	-214
Total	-200 d/	-151	-537	-706	-874	-1,129	-1,343

Table 5

Case 2: Dynamic Impact of Agreement a/
(Continued)

Country and Indicator	Jul-Dec 1971 b/	1972 Jan-Jun	1972 Jul-Dec	1973 Jan-Jun	1973 Jul-Dec	1974 Jan-Jun	1974 Jul-Dec
Netherlands							
Assumed annual real growth of GNP (percent)		3.00	3.00	3.60	4.25 e/	4.90	4.90
Trade balance (Million US $)							
Change		2	-144	-35	-26	-45	24
Total	-130 d/	-128	-272	-307	-333	-378	-354
Sweden							
Assumed annual real growth of GNP (percent) c/		3.00	3.25	3.70	4.10	4.10	4.10
Trade balance (Million US $)							
Change		137	24	23	46	78	74
Total	150 d/	287	311	334	380	458	532
Switzerland							
Assumed annual real growth of GNP (percent)		3.50	4.00	3.80	3.70 e/	3.60	3.60
Trade balance (Million US $)							
Change		-157	-281	-78	-69	-67	-79
Total	-880 d/	-1,037	-1,318	-1,396	-1,465	-1,532	-1,611
United Kingdom							
Assumed annual real growth of GNP (percent)		3.75	3.25	3.60	3.75 e/	4.00	4.00
Trade balance (Million US $)							
Change		-91	-80	23	96	56	126
Total	610	519	439	462	558	614	740
West Germany							
Assumed annual real growth of GNP (percent)		2.00	3.50	3.50	4.35 e/	5.20 f/	5.20 f/
Trade balance (Million US $)							
Change		2,067	-128	621	537	368	702
Total	4,930	6,997	6,869	7,490	8,027	8,395	9,097
Other OECD							
Assumed annual real growth of GNP (percent)		4.00	4.75	5.00 g/	5.25 g/	5.50 g/	5.50 g/
Trade balance (Million US $)							
Change		-1,139	-972	-584	-675	-760	-768
Rest of world							
Assumed annual real growth of GNP (percent) g/		5.00	5.00	5.25	5.50	5.75	5.75
Trade balance (Million US $)							
Change		-152	419	-253	-433	-835	-963

a. Value data are seasonally adjusted on a semi-annual basis; percentage data on an annual basis.
b. Preliminary; for full year, see Table 2.
c. Entries for 1972 are composites of OECD and national estimates. Entries for the second half of 1973 through the second half of 1974 are OECD long-run estimates of growth.
d. Assumed to be one-half of the 1971 total.
e. CIA assumption for transitional period to long-run growth path.
f. OECD estimates of long-run growth rates.
g. CIA assumption.

be reduced by about \$320 million on a semiannual basis. In the second half of 1972 the trade account would deteriorate an additional \$530 million. In 1972, Japan's overall merchandise trade account would show a surplus of about \$7.8 billion, or nearly the same as in 1971. According to the model, this trade surplus will continue to deteriorate, and it will be reduced to about \$5.8 billion in 1974.

23. Despite West Germany's large effective revaluation, the model predicts that its trade surplus will increase substantially because of the economy's relatively slow anticipated growth during most of the period. The increase in the German trade surplus in the first half of 1972, when the economy is expected to grow at an average annual rate of only 2%, or less rapidly than any other major trading nation, would be unusually large -- about \$2.1 billion. By the end of the three-year period, the German trade surplus would have increased about \$9.6 billion. If German economic growth is more in line with recent experience and so is more rapid than assumed, the trade account improvement, of course, would be substantially less than predicted.

24. None of the European countries except Italy and Switzerland is expected to experience a sharp trade-account deterioration during the 1972-74 period. The French trade account would deteriorate by about \$730 million. The British trade account, according to the model, will improve by about \$650 million because of the economy's relatively slow anticipated growth. EC entry and poor export price performance, however, could offset the expected UK trade-account improvement. The Swiss, who, despite a large trade-account deficit in 1971, revalued their currency by a greater amount than any country except Japan, are expected to experience increasing deficits through the period.

25. Canada's trade surplus -- assuming the Canadian dollar continues to trade at near parity with the US dollar -- is shown as increasing on an annual basis by about \$870 million over the period. Although the Canadian surplus would increase about \$280 million in the first half of 1972, it would decline in the second half of the year. The annual surplus for 1972 -- \$2 billion (based on Canadian export and import data) -- would be slightly smaller than in 1971. Canada's trade account, on a semiannual basis, would improve by about \$320 million in 1973 and by about \$350 million in 1974. The improvement is due, in part, to the assumed rapid economic growth in the United States, Canada's most important trading partner.

A Note on the Balance of Payments

26. The CIA trade-flow model does not permit the user to relate the parity changes to elements of the balance of payments other than the trade

account. The current-account and basic balances of a devaluing country are likely to improve, however, by more than the improvement just on merchandise trade account. Particular elements of the service account are very sensitive to parity changes. Expenditure on travel, for example, is probably about as responsive to changes in exchange rates as is expenditure on traded goods. Investment earnings are probably relatively insensitive in the short run to parity changes. In the long run, however, the realignment may increase profitability in the devaluing country, thereby increasing the outflow of investment remittances. Certain elements of the capital account are quite sensitive to parity changes. Production will probably become more attractive in a devaluing country because of the exchange rate change. Multinational companies will therefore choose to "source" more of their output there, which will tend to increase the net inflow of new direct investment.

27. Portfolio investment and short-term capital flows are probably relatively insensitive to parity changes. Short-term capital moves primarily in response to interest-rate differentials and expectations as to future exchange-rate changes. A devaluing country's short-term capital inflow will consequently increase only if that country also has higher interest rates or is expected to appreciate its currency.

Conclusions

28. The CIA trade-flow model predicts that the 18 December 1971 agreement to realign exchange rates will substantially strengthen the US merchandise trade account and the US balance of payments. Although the trade account will deteriorate in 1972 by about $800 million, an annual surplus of $2.8 billion can be expected by 1975, for a swing of about $5.6 billion in a three-year period. The very large Japanese, German, and Canadian trade-account surpluses will continue through the period. Indeed, Germany's trade surplus is expected to increase substantially because of its relatively slow economic growth.

APPENDIX

The Model: Its Assumptions and Limitations

Description of the Model

The revised CIA trade-flow model is designed to forecast the effect of real-output and exchange-rate changes on the pattern of trade balances. It is based on the modified-share approach—that is, apart from the effect of price changes, each exporting country is assumed to maintain its share of trade by value with each importing country.

The model identifies 13 countries or groups of countries: Belgium-Luxembourg, Canada, France, West Germany, Italy, Japan, Netherlands, Sweden, Switzerland, United Kingdom, United States, rest of OECD (excluding Australia and Yugoslavia), and the rest of the world; and five classes of goods: food, beverages, and tobacco (SITC 0-1); crude materials (SITC 2-4); mineral fuels (SITC 3); and manufactures (SITC 5-9); and a class of nontraded goods and services. A good produced by a particular country—here named a "product"—is assumed to have special characteristics that differentiate it from similar goods produced elsewhere. In total, the model includes 65 (13 x 5) different products, each supplied by one country.

World demand for a particular product is related to three factors: to the distribution of trade, to changes in each of the 13 countries' or areas' total monetary expenditure on all goods and services, and to changes in relative prices among similar products.

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Data Inputs

Three types of numerical inputs are required for the model: first, a matrix of trade data showing commodity flows within and from all countries or areas; second, a list of parameters indicating the strength of the causal linkages among changes in various flows; and third, the input-output coefficients for the "cost-push" equations. Data on foreign merchandise trade in the CIA model are in the form of a 5 x 13 x 13 export matrix for 1970; the data are expressed in annual averages in millions of US dollars. The matrix is derived from OECD market summaries and includes (along the diagonal) values representing internal trade in each country. It was assumed that each country's internal trade in each product, by value, was equal to twice the value added in that product's production, less exports. The parameter values used in the model are the same as those employed by the IMF, except in the case of Japan. The demand parameters used are summarized in Table A1, the supply elasticities are summarized in Table A2. The input-output coefficients are derived from standardized input-output tables prepared by the UN Economic Commission for Europe.

Sensitivity of the Model

While the trade data are quite solid, the problem is that the parameter values have to be econometrically estimated or assumed. Clearly, caution must be exercised in using the model. The results are sensitive to the particular parameter values chosen, and the parameter values themselves are subject to wide margins of error.

To test the sensitivity of the model, several simulations using alternative elasticity values were run. In each simulation, 20 sets of elasticity values for a particular set of parameters were drawn from a modified normal distribution, with the mean approximately equal to the value assumed for the set of parameters in the tables, and with the variance equal to twice the mean.[2] The results of

[2] The normal distribution was modified—by taking the absolute value of the selected number—so that the distribution contained no value with a sign reversed from the parameter values originally assumed.

Table A1

Demand Parameters [1]

	Food	Crude Materials	Fuels	Manufactures	Non-traded
Price elasticity of demand for the good	−0.50	−0.50	−0.50	−1.00	−1.10
Elasticity of substitution between similar products	−1.50	−1.50	−1.50	−2.50	—
Expenditure elasticity of demand for the good	0.50	0.50	0.50	1.00	1.10

[1] Assumed to be the same for each country, with respect to quantity.

Table A2

Price Elasticities of Supply [1]

	With Respect to a Change in the Price of:				
	Food	Crude Materials	Fuels	Manufactures	Non-traded
Food	2.0	0.0	0.0	−0.3	−0.7
Crude materials	0.0	1.0	0.0	−0.3	−0.2
Fuels	0.0	0.0	0.0	0.0	0.0
Manufactures	−0.1	−0.05	0.0	3.0	−1.2
Non-traded	0.0	−0.02	0.0	−0.7	3.0

[1] Assumed to be the same for each country, with respect to quantity. For the rest of world, the direct price elasticity of supply for food was taken equal to 1.0; and the cross-elasticities of supply with respect to a change in the price of manufactures and non-traded goods were taken equal to −0.2 and −0.3, respectively. For Japan the direct price elasticity of supply for food was taken equal to 3.0; for crude materials, 1.5; for manufactures, 4.5; and for non-traded goods, 4.5.

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Table A3

Sensitivity to Parameter Assumptions
(Million US $)

Country	Mean Impact with New Values	Range of Impact with New Values	Standard Deviation of Impact with New Values
	Price and Expenditure Elasticities of Demand [1]		
United States	16,242	6,500	1,825
Japan [2]	-10,636	5,253	1,404
Canada	-2,313	1,524	436
France	-149	1,526	397
United Kingdom	-3,016	2,612	698
West Germany	-6,020	3,145	895
	Elasticity of Substitution [3]		
United States	16,957	21,031	5,207
Japan [2]	9,910	10,746	2,991
Canada	-2,400	3,657	1,031
France	-217	1,648	350
United Kingdom	-3,277	4,346	1,128
West Germany	-5,656	6,144	1,087
	Price Elasticities of Supply [4]		
United States	16,147	6,608	1,397
Japan [2]	-9,100	4,183	1,094
Canada	-2,234	1,565	338
France	182	1,608	385
United Kingdom	2,845	1,467	333
West Germany	-6,156	5,849	1,204

[1] Twenty sets of price and expenditure elasticity of demand values are drawn from a modified normal distribution with a mean of 0.75 and a variance of 1.5.

[2] Excluding quota effect.

[3] Twenty sets of elasticity of substitution values are drawn from a modified normal distribution with a mean of 2 and a variance of 4.

[4] Twenty sets of price elasticity of supply values are drawn from a modified normal distribution with a mean of 2 and a variance of 4 for the diagonal elements and a mean of 0.05 and a variance of 0.1 for the off-diagonal elements.

the simulations are summarized in Table A3. For six major countries, it presents the mean trade balance impact with the new parameter values, the range of the trade-balance impact with the new values, and the standard deviation of the trade-balance impact with the new values. If the true elasticities are characterized by the assumed distribution, which seems roughly reasonable, then in at least 75 of 100 cases the actual equilibrium trade-balance impact will be within a range, plus and minus two standard deviations, around the mean.[3]

The model does not appear to be especially sensitive to the values chosen for the price and expenditure elasticities of demand or the price elasticities of

[3] Derived, using Tchebycheff's Inequality, assuming the sample mean and variance are accurate estimates of the population mean and variance. If the trade-balances impact is normally distributed the corresponding intervals are 95% confidence intervals.

supply. The 75% confidence interval for the US equilibrium trade-balance improvement ranges from $12.6 billion to $19.9 billion for various price and expenditure elasticities of demand, and from $13.4 billion to $18.9 billion for the various price elasticities of supply.

Unfortunately, the CIA trade-flow model, and the IMF model from which it is derived, are very sensitive to the assumptions made about the elasticities of substitution. The 75% confidence interval for the US equilibrium trade-balance improvement ranges from $6.4 billion to $27.5 billion for various elasticities of substitution.

Accuracy of the Model

The ultimate test of the model and of the parameter values chosen is the model's ability to forecast accurately the effect of changes in real output and exchange rates on the trade balances. There has been no opportunity to test the model.